ANGLER SURVEY: ANALYSIS OF SIGN EFFECTIVENESS AND ANGLER AWARENESS OF SAN FRANCISCO BAY FISH CONSUMPTION ADVISORY

BERKELEY, CA, 1995

Pesticide and Environmental Toxicology Section
Office of Environmental Health Hazard Assessment
California Environmental Protection Agency

Angler Survey: Analysis of Sign Effectiveness and Angler Awareness of San Francisco Bay Fish Consumption Advisory, Berkeley CA, 1995

by

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EXECUTIVE SUMMARY

In December 1993, the Office of Environmental Health Hazard Assessment (OEHHA) issued a revised sport fishing advisory for striped bass in San Francisco Bay due to mercury contamination. The advisory provided new consumption recommendations for these fish. OEHHA was strongly urged by members of its advisory committee, the Education and Outreach Task Force on Fish Consumption and Fish Contamination Issues, to also post warnings at fishing locations. On a one-time trial basis, OEHHA created multilingual signs about the advisory, and these signs were posted at the Berkeley Pier and Dumbarton Pier in October 1994. Following this posting, the task force also recommended a follow-up survey to determine the effectiveness of the warning signs and to assess anglers' general awareness of sport fish contamination in the bay. This report presents the results of this survey, which was conducted at the Berkeley public fishing pier.

Bilingual interviewers were chosen who were native speakers of the languages represented on the sign: Spanish, Chinese, Vietnamese, Cambodian, and Korean. They interviewed a total of 520 anglers during June and July 1995 using a prepared questionnaire. Questions covered their fishing activities at Berkeley pier, whether or not they had seen warning signs or were aware of the advisory, and their reactions to warning signs. Anglers were also asked whether they had changed their fish consumption habits as a consequence of the advisory. Finally, they were asked what they felt would be the best way to reach anglers with information about sport fish contamination.

Anglers tended to be adults between the ages of 25 and 44 years. A total of 351 (67.5%) of the anglers said they had heard of or seen the fish consumption advisory. Approximately half (53.7%) of the anglers surveyed recalled exposure to the advisory without prompting. When asked where they had heard or seen the warning, the largest percentage of this first group (39.9%) reported seeing a sign, followed by newspaper (21.3%), and friend (9.8%). Anglers who did not remember having seen or heard of the advisory when first asked were asked a second and third time more specifically if they had seen the sign. Sixty additional anglers (11.5%) reported seeing signs after general

prompting and 13 more (2.5%) remembered seeing signs when asked specifically if they had seen the sign at the Berkeley pier. These additional anglers were categorized in the second and third recall groups depending on their level of prompting. Due to the small numbers in the second and third recall groups, only percentages from the first group are used in the summary and discussion.

The survey included several questions to determine anglers' understanding of and attitudes about the advisory, and how it affected them. Most of the anglers who were aware of the advisory demonstrated a general understanding of its meaning when asked.

About 27% of anglers in the first recall group reported changing their eating habits as a consequence of the warnings. Although they viewed the warnings as important, most anglers did not change their eating habits primarily because they did not catch, eat any, or eat very much striped bass from the bay.

The two most common changes described by anglers who had reported that they had changed their eating habits were "Stopped eating certain kinds of bay fish" (31.5%) followed by "Eat more commercial fish" (12.3%). Others reported that they stopped eating fish entirely or any fish caught in the bay (8.2% each). Only one angler reported preparing or cooking fish differently as a result of the warning.

A little over one third of the anglers said they already knew about the advisory or that the bay was polluted before they saw the sign. Many, however, described their first thoughts upon seeing the sign as surprise and concern, and a few were angry. English-speaking anglers were more likely than others to report that they already knew the information on the warning signs.

When asked what they thought were the best ways of communicating with people fishing from the bay, anglers responded that signs posted at fishing locations would be useful, 26.7%; followed by television, 17.1%; newspaper, 13.1%; radio, 8.3%; and "other," 10.3%. Television and radio were more favored by anglers who were interviewed in Spanish than those interviewed in English or Asian languages, but the numbers in interviews in languages other than English were few.

Following the advice of health advisories was seen as "very important" by 61.5%

of the anglers, and "important" by an additional 24.9%. Only 10.4% considered following the recommendations "not too important," and 2.7%, "not important at all." English-speaking anglers gave more importance to following the advice of health advisories than Spanish-speaking or Asian-language-speaking anglers.

This survey was intended to be a measure of the signs versus other sources of knowledge about the advisory and, to a lesser extent, a measure of the advisory's effect on angler behavior. Several factors may have influenced the results obtained by this survey. An important one, especially in terms of effects on angler behavior, was that striped bass are not commonly caught from fishing piers. Thus, many anglers may not have said that they were eating less fish because they were not catching these fish in the first place. Another was that the sign posted at this pier was placed high up on a wall to try to keep it out of reach of vandals. More signs, placed at eye level, might have given different results. If the survey had been conducted where no signs were posted, however, signs might have been mentioned less frequently as a way of learning about the advisory. Efforts were made to use bilingual translators who were native speakers so as to overcome language or ethnic barriers. The level of awareness of sport fish contamination may have been higher than otherwise due to release of a pilot study report that presented the first comprehensive analysis of contaminants of fish in the bay. The pilot study report was released between the time the striped bass advisory signs were posted and the survey interviews were conduced, and it received considerable publicity.

Although this survey was conducted at only one site, the results give information on anglers' awareness of the advisory, which will be useful in conducting additional education and outreach efforts and in measuring the results of such efforts. The survey clearly suggests that signs are an effective way of reaching anglers with information about sport fish contamination and fish consumption guidelines to protect their health. While most anglers learned of the warning through signs, the survey also shows other information sources are important. It also demonstrates differences among ethnic groups in how they regard advisories and prefer to be communicated with. Both these findings

are consistent with the results of other surveys of this type, as reviewed in the discussion section, and have important implications for conducting education and outreach programs.

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INTRODUCTION

Due to the presence of chemicals in the aquatic environment, fish may become contaminated, and this presents a health concern to humans if the fish are eaten regularly. In California, the Office of Environmental Health Hazard Assessment (OEHHA) in the California Environmental Protection Agency assesses the potential risks of consuming chemicals in fish, and when warranted, issues health advisories, including fish consumption guidelines (i.e., no eating or reduced eating of certain species in contaminated areas). A health advisory for the San Francisco Bay and delta region had been in effect since 1972 recommending limited striped bass consumption due to methylmercury contamination. OEHHA reviewed the basis for the advisory, using more updated monitoring data, and issued a new advisory, including revised fish consumption guidelines, in December 1993.

Soon after advisory updating was begun, several sport fishing and environmental groups requested that multilingual signs be posted at public fishing spots around the bay to warn anglers of the hazard. In response to these requests, OEHHA organized the Education and Outreach Task Force on Fish Consumption and Fish Contamination Issues to advise OEHHA regarding preparing signs and doing outreach and education efforts involving the San Francisco Bay area's ethnic communities. Community groups represented on the task force included Save San Francisco Bay Association (SSFBA), Asian Pacific Environmental Network (APEN), and SAFER!, an angling group. State and local agencies were also represented, including California Department of Health Services (DHS), California Department of Fish and Game, and the U.S. Fish and Wildlife Service. OEHHA and the task force worked together to develop the wording on the signs, to determine which languages should be on the signs, and to identify fishing sites where the signs could be posted. A 24 by 36 inch sign was created containing text in English, Spanish, Chinese, Vietnamese, Cambodian, and Korean (English text is shown in Appendix A). The signs were posted in October 1994. Although more than 40 fishing sites were initially identified for possible posting, the signs were only put up at the

Berkeley and Dumbarton piers due to the cooperation of these jurisdictions. Complex sign design and review requirements issued by the jurisdictions at other sites prevented further posting. No state program existed for posting advisory signs, and this posting was considered a one-time pilot project by OEHHA while other arrangements would be explored for future postings.

After the signs were posted, the task force recommended conducting a survey to determine how effective the signs were. A survey could help determine whether anglers saw the signs, whether they remembered the message on the signs, and what, if any, effect the signs had on angler consumption habits. This information could prove useful in assessing whether sign posting is an effective method for communicating to anglers and their families with information about protecting their health when sport fishing, and could guide posting efforts in the future. The task force advised that it would also be useful to obtain baseline information about anglers' fishing and consumption habits for developing educational materials and for measuring the effects of future education efforts.

STUDY DESIGN AND IMPLEMENTATION

The study was designed and carried out by the Pesticide and Environmental Toxicology Section (PETS) of OEHHA. After contacting several national experts on fish consumption surveys, and conducting a review of the available research literature, the initial survey objectives were developed in early 1995. The objectives fell into four categories: determining baseline angler fishing behavior, measuring angler awareness of the striped bass advisory through the signs or other media, identifying angler consumption habits, and assessing how angler fishing and consumption behavior may have changed as a result of angler awareness of the health advisory.

Questionnaire design

The questionnaire was developed by OEHHA in consultation with the California Department of Health Service's Environmental Health Investigations Branch (EHIB), and with input from local environmental advocacy groups such as Save San Francisco Bay Association. Although the task force's primary objective for the survey had been to

measure the effectiveness of the striped bass signs, members of the review panel expressed interest in expanding the survey to include other information. They suggested obtaining sport fish consumption and fish preparation data for anglers and their families, as well as information about commercial fish consumption. That data could be used in future risk analyses and health advisories. The expanded draft questionnaire covered the four objective categories described above, solicited quantifiable fish consumption data for sport and commercial fish, and included a creel count of the angler's catch. The questionnaire consisted of 55 questions, and each angler interview was expected to take 30 to 60 minutes.

In early May, OEHHA assessed the resources and planning time required to conduct a comprehensive fish consumption survey that involved multiagency collaboration. The survey objectives were reexamined, and OEHHA decided to focus in the near term on determining the effectiveness of the striped bass warning signs, the primary survey objective identified by the task force. Since signs containing new advisory information were scheduled to be posted sometime in the near future, it seemed necessary to survey anglers regarding the mercury advisory signs as soon as possible. It was decided that OEHHA would concentrate its efforts on planning and conducting a brief angler survey at Berkeley and Dumbarton piers regarding the existing advisory.

The relevant questions were extracted from the comprehensive questionnaire and revised. The resulting questionnaire was pretested on 29 anglers at Berkeley pier over a 2-day period. Twenty-eight of these interviews were conducted in English; one was conducted in Vietnamese. It was not possible to interview three Chinese speakers, two Korean speakers, two Vietnamese speakers, three Spanish speakers, and four anglers who appeared to be Asian but could not or would not identify their primary language. The average interview time was 3.5 minutes. Most anglers were willing to participate in the survey.

A planned weekend pretest at Dumbarton pier could not be completed due to lack of fishing activity. The three-mile road connecting Dumbarton pier to the Visitor Center

at the National Wildlife Refuge was closed in early April 1995 to protect the nesting habitat of the Snowy Plover. Due to limited fishing activity, Dumbarton pier was dropped as a survey site.

Survey location

OEHHA considered the possibility of replacing Dumbarton pier as a location for conducting survey interviews with a local fishing site where signs had not been posted in order to compare angler awareness of the striped bass advisory at the two sites. Two sites, (1) San Mateo pier and (2) the City of Alameda ramp, rock wall, dock, and shore line were considered since both sites support fishing populations similar to that of Berkeley pier (30-49 anglers on an average weekend summer day, as determined by the pressure codes from the Marine Recreational Fishing Statistics Survey). However, both sites presented transportation complications. Moreover, the Alameda site was spread out over a large area of shore (rather than being located on a single pier), making interviews more difficult to organize and conduct. Consequently, both sites were eliminated as potential survey sites. It was therefore decided that all interviews would be conducted at Berkeley pier, which offered the advantages of being easily accessible for the interviewers, popular for fishing, and allowing fishing without a license.

The signs posted at the Berkeley pier were 24 by 36 inches, made of plastic-coated cardboard, and displayed a picture of a striped bass and text in red over a white background (See English sign text in Appendix A). The signs were originally posted at several locations at the pier but only lasted about a week before they disappeared. To discourage vandalism, replacement signs were placed high up the wall of a building housing the rest rooms located near the entrance to the pier. Although nearly out of reach, the sign placed there was still pulled down approximately every two weeks, and had to be replaced frequently. Another sign placed inside the window of the nearby nature center was not vandalized, but few anglers would have passed by it.

Interviewing and survey strategy

After consulting with personnel at the bait store and nature center, and after making several visits to Berkeley pier, an interviewer schedule was devised that primarily followed the maximum currents and high tides when the pier appeared to be more crowded than during other times of the day. To insure that a wide cross section of anglers would be included, interview hours started as early as 6:30 a.m. and ended as late as 8:00 p.m. Interviews were conducted between June 24 and July 16, over a total of 14 days. The interviewers were instructed to approach all anglers encountered on the pier. Thus, all anglers on the pier during the interview hours were asked to participate in the interviews and all who were willing to participate (barring a language barrier) were interviewed.

The surveys were conducted by six bilingual students recruited from the University of California at Berkeley; California State University, Hayward; and Vista College. The languages available in the interviewer pool besides English were Cambodian, Chinese (Cantonese), Chinese (Mandarin), Korean, Vietnamese, and Spanish. These students received a four-hour training before conducting the survey. Not all six students were available to cover every shift, so it is possible that a few interviews were not conducted due to language barriers.

To obtain objective information of anglers awareness of the signs and advisories in general, a strategy was devised to avoid influencing anglers' responses. First, the questionnaire began with an open-ended question about whether anglers had seen or heard of the advisory, and if so, where (Question 9, Appendix B). Later, anglers who had not mentioned the sign in response to question 9 were asked if they had seen a sign on the pier containing health warnings about eating fish caught in San Francisco Bay (question 14). If they said "yes," they were asked questions about it similar to those in the first group. Finally, one more attempt was made to determine if any of the remaining anglers had seen the sign by asking them more specifically if they had seen a sign on the pier that

warned about mercury in striped bass (question 17). The answers to these sets of questions are presented in tables 6-15. The apparent duplication of some tables is due to similar questions being asked of anglers in these three recall-level groups.

Second, so as not to bias response, multiple answers were possible for some questions. The interviewers were instructed to check the boxes that most closely fit the answers they received rather than reading off the possible answers to questions. Answers that did not fit any category were recorded as "other." Note that due to the possibility of multiple answers on some questions, the frequency of response often total more than the number of anglers answering the question.

Although the expectation was to obtain 200 interviews during the survey period, 520 were conducted and recorded. The questionnaires were entered into a database program, and the responses were analyzed using the statistical program SAS.

RESULTS

Demographics

Age, sex, city of origin, and language of interviews

Participants in the survey were 88.3% male versus 8.7% female. Sex of the interviewee was not recorded for 3% of the respondents.

Most of the respondents were adults between the ages of 25 and 44, with the greatest proportion in the range 25 to 34, 27.4%, and a slightly lesser proportion in the 35 to 44 year range, 21.5%. People age 65 and older constituted only 4.2% of the interviewees, Table 1.

TABLE 1

AGE DISTRIBUTION OF RESPONDENTS

AGE	Frequency	Percent
< 18	35	8.2%
18-24	69	16.2
25-34	117	27.4
35-44	92	21.5
45-54	52	12.2
55-64	44	10.3
65+	18	4.2
Subtotal	427	100.0
No answer	93	18.0
TOTAL	520	

Anglers at Berkeley pier came from various cities in the San Francisco Bay area, as well as from other areas. Oakland, 31.3%, and Berkeley, 10.6%, were the most frequently mentioned cities, see Appendix C.

Interviews were conducted in English, 66.3%, as well as Spanish, Chinese, Korean, Vietnamese, and other languages, see Appendix D.

Fishing history at Berkeley pier

Many of the respondents, 39.2%, had fished at Berkeley pier for less than one month when they were interviewed, while 17.5% had fished there 10 years or longer, Table 2.

TABLE 2

LENGTH OF TIME FISHING AT BERKELEY PIER

How long have you fished at Berkeley pier?	Frequency	Percent
Less than one month	204	39.2%
More than one month, but less than 1 year	49	9.4
1-2 years	50	9.6
3-4 years	29	5.6
5-9 years	26	5.0
10 years or more	91	17.5
No answer	71	13.7
TOTAL	520	100.0

Time fishing at other locations

Slightly over half of the anglers interviewed, 51%, had also fished at other places in the bay.

Of those who had fished elsewhere, the most frequent response, 39.0%, was that they had fished at other places in the bay for 10 years or longer, see Table 3.

TABLE 3

LENGTH OF TIME FISHING AT OTHER PLACES IN THE BAY

How long have you fished other places in the bay?	Frequency	Percent
Less than 1 month	23	8.8%
More than 1 month, but less than 1 year	35	13.4
1-2 years	44	16.9
3-4 years	31	11.9
5 to 9 years	26	10.0
10 years or more	102	39.0
Sub-total	261	100.0%
No answer or NA[1]	259= 50%	
TOTAL	520	

[1] As in many other tables, the large portion of “not applicable” (NA) or “no answer” responses is due to the question not being given to all anglers as it did not apply to them. In this example, half the anglers had not fished in other locations and were therefore not asked this question.

Knowledge of fishing advisories

Slightly over half of the interviewees, 278 (53.7%), answered when first asked that they had seen or heard warnings about eating fish caught in the bay. These anglers are referred to as the *first recall group* because they remembered the sign or advisory without further prompting. Other anglers recalled awareness of the advisory when prompted. When their responses are included, the total was 351 (67%).

Places warnings seen or heard

Anglers in the first recall group were asked where they had seen or heard of the warning. Their responses, which are shown in the following table, show that signs were the most frequent source of learning of the warning. [2]

TABLE 4
PLACE WARNINGS SEEN OR HEARD

Where did you see or hear the warning?	Frequency	Percent
Sign or poster	150	39.9
Newspaper	80	21.3
Friend	37	9.8
Television	34	9.0
Radio	22	5.9
Fishing regulations	19	5.1
Family	11	2.9
Bait shop	8	2.1
Warden, ranger, other official, or no answer	1	0.3
Other	14	3.7
Sub-total	376	100.0%
Did not see or hear of a warning or NA	242= 46%	
TOTAL over all possible answers	618[3]	

[2] The questionnaire asked about "sign or poster." Actually, there were no posters about the striped bass advisory. Therefore, further discussion will only refer to signs.

[3] As noted earlier, the total of answers may exceed the number of interviewees when multiple answers were allowed.

Where saw sign

Anglers in the first recall group who indicated that they had seen a sign or poster, were also asked where they had seen it (Question 9). Approximately three quarters of these anglers responded that they had seen it at the Berkeley pier, but responses recorded as "Berkeley" or "marina" are tabulated as also being the Berkeley pier.

TABLE 5

Where did you see the sign?	Frequency	Percent
Berkeley pier	111	74.0%
Other[4]	11	7.3
Did not answer	28	18.7
Sub-total	150	100.0
NA	370	
TOTAL	520	

[4] "Other" included Dumbarton Bridge (1), where the sign was also posted, and Richmond pier (1), where another sign was posted for a specific advisory. Anglers mentioned other locations around the bay where mentioned where the striped bass sign was not posted: San Pablo Dam, Pinole pier, Almaden Lake, San Mateo Bridge, and Candlestick Park. Two entries were illegible.

What sign said

When respondents who had seen the sign were asked what the sign said, their most frequent response, 23.3%, was that striped bass contain high levels of mercury (Table 6). The next most common response was that the sign said to beware of certain toxins in some bay fish, 13.1%.

TABLE 6
ANGLERS' REPORTS OF WHAT THE WARNING SAID

What did the warning say?	Frequency	Percent
Don't eat any fish from the bay	4	0.8%
Don't eat certain kinds of fish from the bay	32	6.4
People should eat limited amounts of certain fish from bay	43	8.6
Certain people should eat less fish from the bay	4	0.8
Pregnant women and/or children should eat less fish from bay	11	2.2
Beware of certain toxins in some bay fish	66	13.1
Fish from different places in the bay	7	1.4
The bay is polluted	41	8.2
Striped bass from the bay contain high mercury levels	117	23.3
Don't eat striped bass from the bay	32	6.4
People should not eat bay striped bass larger than a certain size	38	7.6
People should eat limited amounts of striped bass from the bay	60	12.0
Certain people should eat less striped bass from the bay	6	1.2
Pregnant women and/or children should eat less bay bass	20	4.0
Other	20	4.0
Sub-total	501	100.0%
Don't know or no answer	241=46%	
TOTAL over 3 possible answers	742	

Effect of warnings on eating habits

Only 26.7% of the respondents in the first recall group reported that they changed their eating habits after learning of the warning whereas 73.7% did not. Reasons given for not changing fish consumption habits are presented in Table 7a. Reasons that are similar have been aggregated for presenting generalizations.

TABLE 7a

REASON FOR NOT CHANGING FISH EATING HABITS

Why didn't you change your eating habits?	Frequency	Percent
Eat limited amounts of striped bass	202	86.3%
I don't catch any striped bass from the bay	61	26.1
I don't eat any striped bass from the bay	106	45.2
I don't eat very much striped bass from the bay	35	15.0
Don't view warnings as important	20	8.5
I don't think the warning is accurate	5	2.1
I don't think the warning is important	7	3.0
People have been eating fish from the bay for years and they're not sick	8	3.4
Other answers	12	5.2
I need the fish I catch from the bay to feed myself	2	0.9
I need the fish I catch from the bay to feed my family	0	0.0
Other	6	2.6
Don't know	4	1.7
Sub-total	234	100.0%
No answer	309=59%	
TOTAL over 3 possible answers	543	

Most, 86.3%, of the anglers who answered the question said that they ate limited, if any amounts of striped bass. Only 2.1% felt the warning was inaccurate. Finally, only 0.9% indicated that they needed the fish to feed themselves or their families.

Reason for not changing eating habits--by language grouping

The data presented in Table 7a were reanalyzed as indexed by language of interview, Table 7b. The small numbers in the non-English-language groupings make it difficult to obtain reliable statistical differences in making comparisons, but indicate no significant differences in responses to this question.

TABLE 7b

REASONS FOR NOT CHANGING FISH EATING HABITS, BY LANGUAGE OF INTERVIEW (IN PERCENTAGES)

Language of interview	Eat limited amounts of striped bass (percent)	Don't view warnings as important (percent)	Other answers (percent)	Percent	Frequency
English	67.2	6.3	26.5	100.0%	189
Spanish	50.0	6.3	43.7	100.0%	16
Asian	73.7	5.3	21.0	100.0%	19

How eating habits changed

For the 26.7% in the first recall group who did change their eating habits, how did they change? Their responses are presented in Table 8.

TABLE 8

CHANGES TO EATING HABITS AFTER HEARING OR SEEING HEALTH WARNINGS

How did you change your eating habits?	Frequency	Percent
Stopped eating all fish	6	8.2%
Stopped eating all fish from the bay	6	8.2
Stopped eating bay fish that are larger than a certain size	8	11.0
Stopped eating certain kinds of bay fish	23	31.5
Eat limited amounts of certain kinds of bay fish	5	6.8
Give away some or all fish caught in the bay	0*	0.0
Release some or all fish caught in the bay	0*	0.0
Cook and/or clean fish caught in the bay differently than before	1	1.4
Eat more commercial fish	9	12.3
Stopped eating striped bass from the bay	0	0.0
Stopped eating bay striped bass that are larger than a certain size	3	4.1
Eat limited amounts of striped bass from the bay	1	1.4
Give away some or all striped bass caught in the bay	0	0.0
Release some or all striped bass caught in the bay	0	0.0
Other	11	15.1
Sub-total	73	100.0%
No answer or NA	447=86%	
TOTAL	520	

The most frequent response to the warnings was to stop eating certain kinds of fish from the bay, 31.5%. Others, 12.3%, reported that they ate more commercial fish. Many reported that they stopped eating all fish, 8.2%, or stopped eating all fish from the bay, 8.2%. Food preparation changes were reported by only 1.4% of the anglers.

Responses from anglers who did not recall signs

Respondents who did not mention seeing or hearing any health warnings about bay fish when first asked in question 8 were then asked if they had seen any signs on Berkeley pier about fish caught in San Francisco Bay. The questions were asked in this way so as not to bias anglers' recall initially. Sixty anglers (11.5%) reported seeing these warning signs, and they constitute the *second recall group*. These anglers were then asked a series of questions similar to those asked earlier of anglers in the first recall group.

Saw signs somewhere

Fifty-six of the 60 respondents in the second recall group, or 93.4%, reported when asked where they saw the sign (question 14) that they had seen the warning signs at the front of the pier near the rest rooms, Table 9.

TABLE 9

WHERE DID YOU SEE THE SIGN (ON THE PIER)?

Where did you see the sign (on the pier)?	Frequency	Percent
At the front of the pier by the rest rooms	56	93.4%
At the Shorebird Nature Center at the Berkeley Marina	0	0.0%
At the Berkeley Marina Bait Shop	0	0.0
Other	2	3.3
Don't know	2	3.3
Sub-total	60	100.0%
No answer OR NA	464=89%	
TOTAL over 3 possible answers	524	

Understanding of sign message

When asked what these signs said, anglers in the second response group reported information as shown in the following description, Table 10.

TABLE 10

REPORTS OF WARNING MESSAGES AT BERKELEY PIER

What did the sign say?	Frequency	Percent
Don't eat any fish from the bay	0	0.0%
Don't eat certain kinds of fish from the bay	5	7.1
People should eat limited amounts of certain fish from the bay	0	0.0
Certain people should eat less fish from the bay than others	0	0.0
Pregnant women and/or children should eat less fish from the bay than others	1	1.4
Beware of certain toxins in some bay fish	5	7.1
Fish from different places in the bay	0	0.0
The bay is polluted	2	2.9
Striped bass from the bay contain high mercury levels	13	18.6
Don't eat striped bass from the bay	3	4.3
People should not eat bay striped bass that are larger than a certain size	7	10.0
People should eat limited amounts of striped bass from the bay	5	7.1
Certain people should eat less striped bass from the bay than others	1	1.4
Pregnant women and/or children should eat less striped bass from the bay than others	4	5.7
Other	3	4.3
Don't know	21	30.1
Sub-total	70	100.0%
No answer or NA	463=89%	
TOTAL over 3 possible answers	533	

The predominant response, 30.1%, was that they didn't know what the sign said. The next most frequent response, 18.6%, was that striped bass from the bay contain high levels of mercury.

Saw signs at Berkeley pier about striped bass

As a third attempt to assess anglers' awareness of the sign or the advisory, those anglers who had not responded earlier were asked if they had seen signs at Berkeley pier warning about mercury in striped bass. Thirteen (2.5%) reported that they had seen these warnings, and they constitute the *third recall group*.

Of these 13 people, 69.2%, identified having seen the signs at the end of the Berkeley pier near the rest rooms, Table 11.

Table 11

WHERE DID YOU SEE THE SIGN (ON THE PIER)?

Where did you see the sign (on the pier)?	Frequency	Percent
At the front of the pier by the rest rooms	9	69.2%
At the Shorebird Nature Center at the Berkeley Marina	0	0.0
At the Berkeley Marina Bait Shop	0	0.0
Other	4	30.8
Don't know	0	0.0
TOTAL	13	100.0

Understanding of advisory

The understanding of the third recall group about the warning sign for mercury in striped bass, is shown in Table 12.

TABLE 12

WHAT THE SIGN SAID ABOUT MERCURY IN STRIPED BASS

What did the sign say about mercury in striped bass?	Frequency	Percent
Striped bass from the bay contain high mercury levels	4	36.3%
Don't eat striped bass from the bay	0	0.0
People should not eat bay striped bass that are larger than a certain size	1	9.1
People should eat limited amounts of striped bass from the bay	0	0.0
Certain people should eat less striped bass from the bay than others	0	0.0
Pregnant women and/or children should eat less striped bass from the bay than others	1	9.1
Other	2	18.2
I don't know	3	27.3
Sub-total	11	100.0
No answer or NA	511=98%	
TOTAL over 3 possible answers	522	

Did eating habits change?

Anglers in the second and third recall-level groups who reported seeing the signs were asked if they had changed their eating habits. Only 7 (20.6%) said "yes," while 27 (79.4%) said "no," Table 13.

TABLE 13
DID YOU CHANGE YOUR EATING HABITS?

Did you change your eating habits (after you saw the sign)?	Frequency	Percent
Yes	7	20.6%
No	27	79.4
Sub-total	34	100.0
No answer or NA	486=93%	
TOTAL	520	

Why did not change eating habits

Of the anglers in the second and third recall groups who answered why they did not change their eating habits, most, 61.6%, reported that they ate limited amounts of striped bass. Others indicated that they did not catch or eat striped bass from the bay. Concerning importance of the warning as a reason, 19.2% did not view the warnings as important. No one gave the reason that they needed the fish to feed themselves or their families, Table 14.

TABLE 14

WHY DIDN'T YOU CHANGE YOUR EATING HABITS?

Why didn't you change your eating habits?	Frequency	Percent
Eat limited amounts of striped bass	16	61.6%
I don't catch any striped bass from the bay	9	34.7
I don't eat any striped bass from the bay	4	15.4
I don't eat very much striped bass from the bay	3	11.5
Don't view warnings as important	5	19.2
I don't think the warning is accurate	0	0.0
I don't think the warning is important	1	3.8
People have been eating fish from the bay for years and they're not sick	4	15.4
Other answers	5	19.2
I need the fish I catch to feed myself	0	0.0
I need the fish I catch to feed my family	0	0.0
Other	1	3.8
I don't know	4	15.4
Sub-total	26	100.0
No answer or NA	495=96%	
TOTAL over 3 possible answers	521	

How did change eating habits

Of the few anglers in the second and third recall groups who said that they changed their eating habits after seeing the warning signs about mercury in striped bass, 4 reported stopping eating all striped bass from the bay and 2 reported stopping eating striped bass larger than a given size, Table 15.

TABLE 15

HOW DID YOU CHANGE YOUR EATING HABITS?

How did you change your eating habits?	Frequency	Percent
Stopped eating all fish	1	10.0%
Stopped eating all fish from the bay	1	10.0
Stopped eating striped bass from the bay	4	40.0
Stopped eating striped bass that are greater than a certain size	2	20.0
Eat limited amounts of striped bass from the bay	0	0.0
Release some or all striped bass caught in the bay	0	0.0
Eat more commercial fish	0	0.0
Other	1	10.0
I don’t know	1	10.0
Sub-total	10	100.0
No answer or NA	511=98%	
TOTAL over 3 possible answers	521	

Thoughts about the sign

A series of questions was asked of anglers in all three recall groups who had mentioned seeing the sign. The first question asked what their thoughts were when they first saw the sign warning about mercury in striped bass. The answers were as follows:

TABLE 16a

THOUGHTS WHEN THEY FIRST SAW THE MERCURY IN STRIPED BASS WARNING SIGN

What were your thoughts when you first saw the mercury in striped bass signs?	Frequency	Percent
I already knew info. on sign / bay was polluted	80	35.4
I already knew the information on the sign	24	10.6
I was not surprised/ I knew the bay was polluted	56	24.8
I was surprised / angry / concerned	90	39.8
I was surprised/ I had no idea	37	16.4
I was angry	10	4.4
I was concerned	43	19.0
Other answers	56	24.8
I didn't care	28	12.4
Other	28	12.4
Sub-total	226	100.0%
No answer or NA	327=63%	
TOTAL over 3 possible answers	553	

Of the respondents, 35.4% reported that they already knew the information on the sign or knew that the bay was polluted. Almost 40% reported that they were surprised, angry, or concerned, and 12.4% reported that they did not care about the warning message.

Thoughts about the sign--by language groupings

English-speaking respondents were more likely to report that they knew the information on the sign or that they knew that the bay was polluted; 40% compared with Spanish-speaking, 15.4%, or Asian-language-speaking, 18.2%, respondents, Table 16b. Spanish-speaking respondents were more likely to report being surprised, angry, or concerned.

TABLE 16b

THOUGHTS WHEN THEY FIRST SAW THE MERCURY IN STRIPED BASS WARNING SIGN, BY LANGUAGE OF INTERVIEW (IN PERCENTAGES)

Language of interview	I already knew info. on sign / bay was polluted	I was surprised / angry / concerned	Other answers	Percent	Frequency
English	40.0	36.6	23.4	100.0%	175
Spanish	15.4	65.4	19.2	100.0%	26
Asian languages	18.2	36.4	45.4	100.0%	22

Best ways to communicate advisories

When asked to report the best ways to reach people fishing from the bay, interviewees responded as follows (Table 17a).

TABLE 17a

BEST WAYS TO REACH PEOPLE FISHING FROM THE BAY

What are the best ways to reach people fishing from the bay?	Frequency	Percent
Signs at fishing locations	183	26.6
Television	117	17.1
Newspaper	90	13.1
Posters or leaflets at bait shop	60	8.7
Radio	56	8.3
Talking to anglers at fishing locations	39	5.7
Fishing regulations	19	2.8
Other	71	10.3
Don't know	51	7.4
Sub-total	686	100.0%
No answer or NA	80=15%	
TOTAL over 3 possible answers	766	

Posting signs at fishing locations received the most frequent response, 26.7%, followed by television and newspapers. If aggregated, public media (television, newspaper, and radio) were identified as the best way to reach people by 38.5%.

Best ways to communicate--by language groupings

Responses to how to reach anglers were examined by language of interview, Table 17b. Signs at fishing locations are still most frequently selected as the best way of communicating to English and Asian language speaking anglers, but television and radio were clearly preferred by Spanish speaking interviewees.

TABLE 17b

BEST WAYS TO REACH PEOPLE FISHING FROM THE BAY, BY LANGUAGE OF INTERVIEW (IN PERCENTAGES)

	English	Spanish	Asian languages
Signs at fishing locations	29.5	16.7	38.3
Television	15.3	41.6	19.1
Newspaper	15.3	6.9	14.9
Posters or leaflets at bait shop	10.6	4.2	4.3
Radio	6.9	22.2	8.5
Talking to anglers at fishing locations	6.7	2.8	4.3
Fishing regulations	3.5	1.4	0
Other	12.2	4.2	10.6
TOTAL over 3 possible answers	100.0%	100.0%	100.0%

Importance of advisories

Toward the end of the survey, respondents were asked how important they felt it was to follow health advisories. Their answers are presented in Table 18a.

TABLE 18a

IMPORTANCE OF FOLLOWING HEALTH ADVISORIES

How important do you think it is to follow health advisories?	Frequency	Percent
Very important	271	61.5%
Important	110	24.9
Not too important	46	10.4
Not important at all	12	2.7
Don't know	2	0.5
Sub-total	441	100.0%
NA	79=15%	
TOTAL	520	

More than 86% of the respondents reported that they felt it was "very important" (61.5%) or "important" (24.9%) to follow health advisories.

Importance of advisories--by language groupings

Asian language interviewees gave less importance to the value of following health advisories. Almost 30% of them felt that it was either not too important or not important at all to follow fish advisories, Table 18b.

TABLE 18b

IMPORTANCE OF FOLLOWING HEALTH ADVISORIES, BY LANGUAGE OF INTERVIEW (IN PERCENTAGES)

Language of interview	Very impt.	Impt.	Not too impt.	Not impt. at all	Percentage	Frequency
English	65.9	22.2	9.2	2.7	100.0%	338
Spanish	47.5	50.0	2.5	0.0	100.0%	40
Asian languages	42.8	26.8	25.0	5.4	100.0%	56

DISCUSSION

Our objectives in this survey were (1) to determine the effectiveness of the signs as a communication method and (2) to obtain baseline information about anglers' awareness of the striped bass advisory that could be used to measure the effectiveness of future education and outreach efforts. To evaluate these objectives, we examined how often signs compared with other methods were mentioned as a source of information about the advisory, how well anglers understood the advisory, how the advisory affected their behavior, and what reaction the signs produced in the mind of the viewer. This evaluation was carried out on the recommendation of OEHHA's education and outreach advisory task force, and is consistent with guidelines promulgated by U.S. EPA (1995) on risk communication concerning fish consumption advisories.

Because our survey was conducted in the context of obtaining information that would help in designing ongoing outreach and education efforts, we decided to review other surveys that have examined anglers' awareness and compliance with advisories. Some of the main findings of these surveys are included in this discussion to provide comparisons with results from our Berkeley pier survey and to highlight important elements to consider in educational activities. The surveys we reviewed included the following. The Human Dimensions Research Unit at New York State College of Agriculture and Life Sciences has done several studies looking at angler response to advisories (HDRU Series, 1992-3). These studies consisted of questionnaires mailed to up to 30,000 licensed anglers in New York, and the Lake Ontario, Great Lakes, and Ohio River Valley areas. The Santa Monica Bay Seafood Consumption Study (SCCWRP and MBC, 1994), while primarily a consumption study, also provides some information about angler awareness and behavior. It consisted of more than 1,200 interviews conducted on piers, boats, and beaches. West et al. (1993) also conducted a consumption study with a survey mailed to 7,000 licensed Michigan sport anglers; it also included questions about anglers' awareness and changes in behavior. May and Burger (1996) examined fish consumption and risk perception of urban fishers in the New York/New Jersey estuary, in areas where there were consumption advisories. They interviewed 318 persons who were

fishing or crabbing. Diana et al. (1993) studied 304 sport anglers' understanding of the fish contamination situation in Lake Ontario and their compliance with the advisories.

Awareness of advisory

When asked if they had heard or seen an advisory, 278 (53.7%) of anglers at the Berkeley pier responded affirmatively. Other anglers recalled awareness of the advisory when prompted. When their responses are included, the total was 351 (67%). It should be noted, however, that the issuance of a more recent advisory for San Francisco Bay may have influenced the level of affirmative response to this question. Between the posting of the striped bass advisory signs in October 1994 and when the survey interviews took place in summer 1995, a new advisory was issued in December 1994 based on a pilot study of fish contamination in the bay. This study, which was covered widely in the media, found contamination in all fish species tested. Except for a few species that would probably not be contaminated (e.g., migrating salmon), limited consumption was recommended for all fish in the bay on an interim basis until a comprehensive analysis of the results is concluded. No new signs were posted about the interim advisory at the time of the survey, but anglers could have been exposed to news stories about the new study and advisory. Knowledge of the new advisory may have increased their awareness and influenced some to make changes in their fishing habits, as reflected in this survey.

Nevertheless, angler awareness in San Francisco Bay was not high in comparison with other surveys that we reviewed. In the Santa Monica Bay study, which was similar in conducting field surveys, awareness was 77%. Surveys that used questionnaires mailed only to licensed anglers had particularly high awareness results. For the HRDU study series, awareness ranged from 80% to 92%. West (1993) reported 39% general awareness, and 56% specific awareness as to species and locations, for a total 95%. Increased awareness in these other surveys may have been due to several factors including more literate anglers responding to the surveys, many more species of fish being included under the advisories rather than just one species, and greater awareness of the contamination problem.

Signs versus other sources of advisory information

Of the Berkeley anglers who recalled seeing or hearing of an advisory (first recall group), 150 (39.9%) said they had seen a sign. The next most often noticed communication medium was newspapers (21.3%). Friend (9.8%) and television (9.0%) came next, with other methods following.

Because some individuals might not have mentioned seeing the signs when first asked about having seen or heard a warning, two more attempts were made to help their recall. Sixty more individuals recalled seeing a warning sign on the Berkeley pier when asked directly, and 13 more remembered when asked if they had seen a sign on the pier about mercury in striped bass. Altogether, 223 individuals (42.8%) out of a total of 520 surveyed recalled seeing a warning sign. Signs were clearly the single most frequently noticed source of information in this survey.

Some particular factors in this survey may have affected the frequency with which anglers mentioned signs as a way of being exposed to the advisory. For example, if we had surveyed anglers who were fishing along the shoreline or at other locations where signs had not been posted instead of on Berkeley pier, signs might have been less frequently cited. On the other hand, signs might have been named even more frequently if several signs had been posted at eye level along the Berkeley pier rather than just a single sign that was placed high up on a wall to protect it from theft or vandalism.

Later in the interviews, anglers were asked what they thought were the best ways of reaching people fishing from the bay. Signs posted at fishing locations again received the most frequent response, 26.7% (Table 17a), followed by television, 17.1%; newspaper, 13.1%; radio, 8.3%; and "other," 10.3%. (When broken down by language groups, however, Spanish-speaking anglers rated television the most preferred method, as noted later.)

Some differences may be observed when comparing how anglers responded to the question about how they would like to be reached (Table 17a) with how they said they actually learned of the advisory (Table 4). Newspaper ranked second in Table 4 compared

with third in Table 17a. "Friend," which ranked third in Table 4, did not appear as an alternative in this question, but most closely correlates with "talking with anglers at fishing locations," which ranked sixth in Table 17a[5]. Anglers ranked the fishing regulations guide sixth as a way of reaching anglers (2.8%) in Table 17a, yet the guide was fourth and slightly higher than television and radio as a way that anglers said they actually learned of the advisory (5.7% in Table 4). Thus the regulations guide, which contains the health advisories for the whole state, should not be discounted as a means of reaching anglers, even if anglers are not required to have fishing licenses when fishing from public fishing piers.

The responses discussed above indicate that anglers learned about the striped bass advisory from signs more than any other method, and, moreover, on the whole, they prefer signs as a way of being reached. These responses reinforce each other and lead to a stronger conclusion in favor of signs as a preferred communication tool.

Velicer and Knuth (1994) suggested that if the message is delivered via the most preferred medium, it will have a greater chance of success. This further suggests that signs should be used to provide warnings in the San Francisco Bay area. However, they also found that different target audiences have different information needs and thus it would be better to use a variety of media. For example, they reported that low income persons relied more on mass media whereas members of angling associations and party boat owners relied on regulations guides, newsletters, and newspapers.

The use of multiple means to reach different audiences was also discussed in other survey reports. West et al. (1993) and HDRU Series No. 93-9 recommend using targeted media to reach different groups, with emphasis on reaching those with the highest risk behavior. West et al. (1993) and the HDRU series noted that contact with experts and

[5] "Friend" was not included among these response possibilities because it was unclear how a friend would be informed.

fishing regulations guides were particularly effective in bringing about relatively high levels of advisory awareness, knowledge, and compliance with recommendations. It was noted, however, that the people who filled out these mailed surveys were people who had some degree of reading ability because of the complexity of the instructions needed to complete them.

HDRU Series 92-9 found that posted warnings were used by nonwhite anglers, low income anglers, and anglers in households with children. It further noted that because these groups are considered among high-risk anglers, the message on the postings should be evaluated for adequacy of warning. HDRU Series 93-3 reported that anglers rated fishing regulations guides and posted warnings as the two most important sources of advisory information. HDRU Series 93-6 noted that newspapers and postings appeared to be particularly important in urban areas.

May and Burger (1996) found that newspapers/magazines were the most common source of information, followed by signs. They further noted that in one study area the number of people who reported learning of warnings by signs increased from June (4%) to September (36%) presumably due to the posting of signs at two sites in the region. However, as discussed later, due to misperception of risk, awareness of the advisories alone did not cause the fishers to change their fishing or consumption.

Understanding of and attitudes toward the advisory

To determine if anglers understood the warning, we asked what the warning said. For the first recall group, the question did not distinguish between the sign versus other methods of learning of the warning (Table 6). The most frequent response (23.3%) was that striped bass from the bay contain high mercury levels, and the second most frequent response (13.1%) was “Beware of certain toxins in bay fish.” Other responses to this question showed good comprehension of other aspects of the advisories, such as the advice that pregnant women and children should eat less striped bass. Table 12 shows that anglers in the second and third recall groups also had a good understanding of what the sign said.

The survey included questions to determine anglers' attitudes or reactions toward the advisories or signs. One question asked generally, "How important do you think it is to follow health advisories?" Most (86.4%) of the anglers responded that following health advisories was "very important" (61.5%) or "important" (24.9%) versus about 13% who felt it was of little or no importance (Table 18a). From this response, it seems likely that more anglers than indicated by Table 8 would have changed their eating habits if the advisory on the sign had been more applicable, that is, if the advisory had covered more commonly caught species rather than just striped bass.

Another question asked anglers about their first thoughts on seeing the sign. About a third of interviewees said they were not surprised by the information or knew that the bay was polluted (Table 16a). Only 10.6% specifically responded that they already knew the information on the sign, so for the majority of anglers the sign may have given them consumption recommendations that they might not have known otherwise. A significant percentage of anglers expressed "surprise" (16.4%) and "concern" (19%). Others indicated that they "didn't care" (12.4%) or gave answers recorded as "other" (12.4%). This may reinforce that impression that anglers take advisories seriously.

Effects on fishing and consumption behavior

One possible measure of the signs' effectiveness is whether they caused people to change their behavior or consumption. Unfortunately this survey had several complications that make the effect of signs alone on angler awareness and effect on eating habits difficult to assess. One is that many respondents had heard of the striped bass advisory by other means, and the effect of signs cannot be clearly separated from the effect of learning of it from other sources. This problem is further complicated because the San Francisco Bay pilot study on fish contamination and the new interim advisory were released in late 1994 before the angler survey was conducted. Because the pilot study was the first broad look at chemical contamination in fish in the bay, it received considerable media coverage. Another complication is that the advisory on the sign only concerned

striped bass, a type of fish that is not frequently caught by pier anglers. Consequently, it appears that many anglers felt that the advisory did not affect them. Most anglers (73.3%) responded that they did not change their fish eating habits, and the major reason they gave was that they either did not catch striped bass or eat them (Table 7a). An analysis of the effects on eating habits therefore has to be done with the realization that the number of anglers who responded as having changed their habits was small, the anglers may have heard about either or both advisories, and may have learned of them by means other than signs.

Anglers in the first recall group (26.1%) said that they changed their eating habits after seeing an advisory (Table 8).[6] The main responses from this group were "stopped eating certain kinds of bay fish" (31.5%), "eat more commercial fish" (12.3%), and "stopped eating bay fish that are larger than a certain size" (11.0%). Other respondents said they stopped eating all fish (8.2%) or eating all fish from the bay (8.2%).

The advisories clearly caused some anglers to either stop eating or reduce their consumption of bay fish. Stopping consumption of fish larger than a certain size (striped bass and sharks) is a desirable effect from a public health viewpoint. Stopping consumption of all fish or certain fish from the bay is more extreme than necessary and may raise other concerns if alternative sources of protein are not substituted in the diet. The consumption guidelines in the advisories provide adequate health protection if followed, and substituting a protein with high fat content would be associated with its own set of health risks.

[6] Compare with Table 15, which reports changes made by anglers in the second and third recall groups. Because of the very small numbers in Table 15, it is more convenient to use only the percentages found in Table 8 for this part of the discussion.

Only one person responded to "cook and/or clean fish caught in the bay differently than before" (1.4%). Although this information did not appear on the sign, OEHHA has recommended in the California Sport Fishing Regulations guide and other places that anglers use certain fish preparation and cooking methods to reduce contaminant levels. A response of only 1 out of 73 who responded that to this part of the questionnaire strongly suggests that more education is needed in this area.

Compliance with advisories as cited in other studies and factors influencing effectiveness

We reviewed other surveys to compare angler compliance with advisories and to discover factors that may influence compliance or rejection of the recommendations. Understanding these factors can help educators to conduct effective education that will improve angler acceptance and compliance.

The other surveys we examined indicated that anglers had reduced their consumption of sport fish due to the advisories, but a number of factors reduced their compliance with the consumption recommendations.

Diana et al. (1993) analyzed several hypotheses to explain sport anglers' compliance with the fish consumption advisory for Lake Ontario. They found that knowledge, credence that concern is warranted, and beliefs about health risk facilitated compliance with the advisory. On the other hand, beliefs about the health benefits of eating sport-caught fish, time spent fishing, a tradition of fishing, and a negative perception of the impact of the contaminant situation on oneself and the community reduced compliance with the advisory. These researchers also found that anglers who lived far from Lake Ontario were more likely to have households that consumed restricted fish, suggesting the need for more education efforts being directed toward anglers living far away. Higher levels of household consumption of restricted fish were also characteristic of angler club members and of anglers of low income or high income rather than for anglers of moderate income.

Diana et al. concluded that "if educators can raise anglers' level of knowledge about the fish contaminant situation and related recommendations, anglers may be more likely to believe that health risks are associated with consuming restricted fish, to agree that concern is warranted, and to follow the advisory recommendations. The results also suggest, however, that the impact of such educational efforts on practices may be mediated by other behavior beliefs and angler characteristics." They suggested that credence has a role in explaining behavior, and that educators should take this into account also in designing their messages. Finally, they concluded that "educators, researchers, and regulatory agencies should identify and promote, insofar as possible, fishing and consumption practices that will enable anglers to minimize exposure to contaminants while retaining the benefits they derive from sport fishing."

Knowledge and credence problems may explain noncompliance behavior observed by May and Burger (1996). They found even when fishers know about advisories, they may not change their behavior. They reported that despite hearing the warnings, over 65% of the people interviewed in one study area believed the water and fish to be safe, and 70% admitted to eating their catch in spite of warnings. The fishers believed that the fish were cleaner than the water because they believed the fish were migrating from cleaner waters. They also believed that the crabs could filter out contaminants. Having positive long-term experience with fishing was another explanation the researchers suggested for the fishers' disregard of the advisory. Since the fishers had not experienced acute illness, they did not think that chronic exposure to small amounts of chemicals over time would present a health hazard. They did not have an understanding of bioaccumulation. Many fishers felt they could make the fish completely safe for consumption by using particular cleaning and cooking methods. The researchers reported that even when signs were posted at two sites stating that harvesting and consumption of crabs was prohibited, fishers continued to fish these spots and even set crab traps right in front of the signs.

May and Burger (1996) attribute public distrust toward government as an important factor in fishers ignoring the advisories. They suggest that "agencies issuing advisories must improve their credibility in the public eye, and involving independent parties in sampling, testing, and reporting may help the process of rebuilding trust in government agencies."[7]

Velicer and Knuth (1994) suggested that a target audience's contentment with the risk communication message can serve as a gauge of advisory effectiveness. Other studies mentioned that anglers gave high importance to the advisories, but some did not change their consumption levels because they did not consider the risk of eating the fish greater than other minor risks encountered in life. Others did not realize that they were eating more than the recommended amounts.

HDRU Series, 92-9 and 93-6 found that anglers were more inclined to change their fish preparation habits (cleaning and trimming fat) than changing cooking methods, quantity consumed, or species fished. Diana et al. 1993 found that if anglers had a negative reaction to the contaminant situation, they would not changing trimming practices; if their reaction was positive, however, they were more likely to change trimming and other behavior to protect their health.

Our review of other surveys indicates several factors that are important to consider in designing education and outreach to improve compliance with advisories. Since knowledge is one of the most essential elements associated with compliance, it is clear that an education must program needs to provide more than just a set of recommendations. These surveys have also identified particular groups that need additional educational efforts. In addition to knowledge, credence was found to be important. Agencies that issue advisories are urged to build believability into their messages.

[7] The U.S. EPA guidance document on risk communication (U.S. EPA, 1995) contains a section of recommendations to improve trust and credibility.

Ethnic differences in responses

Given that differences may exist among ethnic subpopulations in terms of responses to different educational approaches and different educational needs, we analyzed the survey responses to several questions to determine whether such differences could be found. The Presidential Executive Order on Environmental Justice (1994) indicates a strong interest at the Federal level to look at effects of environmental contaminants on certain subpopulations and to be concerned with subsistence consumption of fish and wildlife.[8] We used language of interview as an indicator of race and ethnicity because the survey did not contain a question asking about such identity. This turned out to be problematic for data analysis. Although bilingual interviewers were available, more than 80% of the interviews were conducted in English, or the language of interview was not recorded (Appendix D). Some anglers of Asian and Latino ethnicity were probably interviewed in English (Note that 82.8% of the interviewees responded "English" when later asked which language they felt most comfortable speaking [Appendix E].) Racial or ethnic groups such as black and Native American could not be

[8] The presidential executive order recommendations covered a wider range of issues than are included in this survey, but are worthy of note. The order states, "In order to assist in identifying the need for ensuring protection of populations with differential patterns of subsistence consumption of fish and wildlife, Federal agencies, whenever practicable and appropriate, shall collect, maintain, and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence. Federal agencies shall communicate to the public the risks of those consumption patterns." It also states, "...whenever practicable and appropriate, [federal agencies] shall collect, maintain and analyze information on the race, national origin, income level, and other readily accessible and appropriate information for areas surrounding facilities or sites expected to have a substantial environmental, human health, or economic effect on the surrounding populations...."

distinguished at all by using language and an indicator. Thus the ethnicity of most interviewees is not known.

The large percentage of English or unidentified language interviews left a relatively small number in other language groups. This may have accentuated ethnic differences in the analysis because difficulty with English could mean a lesser degree of acculturation. With such small numbers, Asian languages had to be lumped together, and any finer distinctions were lost. Generally, the small number available for these analyses should be taken into account.

The questions we reanalyzed by language of interview were why anglers did not change eating habits (Table 7b), thoughts when they first saw the mercury in striped bass warnings (Table 16b), best ways to reach people fishing from the bay (Table 17b), and importance of following health advisories (Table 18b). We found some clear significant differences in response in the following instances:

> English-speaking respondents were more likely to report that they knew the information on the sign or that they knew that the bay was polluted: 40% compared with Spanish-speaking, 15.4%, or Asian-speaking, 18.2%, respondents (Table 16b).
>
> Spanish language interviewees were more than twice as likely as other language speakers to suggest television and radio as the best way to reach people fishing from the bay (Table 17b).
>
> Asian languages interviewees considered following fish advisories of less importance than those in the other two language groups (Table 18b).

These ethnic differences suggest that greater efforts need to be made to reach non-English-speaking groups. Considering the strong support for public media as a communication means among Spanish-speaking respondents, more attention should be given to using the media to reach this audience. The lower level of importance attributed to health advisories by Asian language speakers may suggest that more personal contact methods should be employed, such as discussions with community leaders or presentations in front of small groups. Fortunately, two local environmental organizations that are represented on OEHHA's education and outreach task force, Save San Francisco Bay Association (SSFBA) and Asian Pacific Environmental Network (APEN), have been conducting outreach to Asian American audiences.

Other surveys we examined noted higher consumption by nonwhites and by lower education and economic groups. West et al., (1993) noted that blacks had higher risk behavior (high consumption and less likely to use preparation and cooking methods that

reduce contaminants), suggesting the need for targeted education. HDRU Series 93-9 said that nonwhite respondents ate more sport fish than whites, with blacks and Asians among the highest consumers; however, Native Americans and blacks made relatively more changes in overall behavior than whites or "Asian/others." Blacks were less likely to fillet the fish or remove the skin although they were as likely to use other contaminant risk-reducing preparation methods, and were also more likely to reuse the oil or fat from cooking than other racial or ethnic groups.

Subsistence fishing

An earlier survey of people fishing on public piers around San Francisco Bay has suggested that many of the anglers are fishing for subsistence.[9] Although this survey did not cover consumption habits directly, there was one question that included it. It was therefore unexpected how few Berkeley pier anglers, who tended to be mainly adult males, responded that they did not change their eating habits because they needed the fish to feed themselves or their families (less than 1%, Table 7a). This low response may have been due to several reasons. One was that the question not being asked directly, or, as noted earlier, the question may have been interpreted as applying to only striped bass, which are infrequently caught from piers. Other possibilities are that anglers may not want to admit needing the fish for food out of pride, or that they consider fishing an activity intrinsic to their culture and thus not something done just as a means of feeding

[9] A report released in 1996, entitled, *Fishing for Food in San Francisco Bay: An Environmental Health and Safety Report from Save San Francisco Bay Association*, states, "Many people come to the shores of the Bay not for the sumptuous spiritual feast , however, but literally to put food upon their tables." The report gives results of a survey of 69 fishers interviewed on piers around the bay. This report seems to be the basis for several newspaper articles suggesting that many people rely on fishing for food.

themselves or their families. Because we were told that anglers might not give truthful or complete answers if asked by interviewers who they did not feel comfortable with, we were careful to hire interviewers who were ethnically representative of the types of anglers they might interview as well as fluent in other languages. Our survey may not tell us much about what percentage of anglers are fishing for subsistence, but the response to this question is worth noting. We found little reference to the question of subsistence fishing in the studies we reviewed. Few respondents in the Great Lakes Study (HDRU Series 93-3) said that they relied on Great Lakes fish as food for themselves or their families. Respondents with lower income or education levels were more likely to rely on Great Lakes fish, but the mean for these groups was still below neutral, indicating disagreement with the statement that they relied on these fish for food. In the New York sport fisheries study, most anglers (64.4%) who were asked why they did not change fishing habits said that they thought they were staying within the recommended consumption guidelines; none gave needing to feed themselves or their families as a reason for not changing (HDRU Series 92-9).

Study limitations

Only one popular fishing site, Berkeley pier, was surveyed during the summer months of June and July in this study. Repeating the study at other fishing sites and at other times of the year would help to confirm the results. Other limitations have already been discussed, including that the advisory referred only to striped bass, which are infrequently caught from piers, and that the signs were not placed in several places where they might have been easier to see.

Conclusions

Our study measured anglers' awareness of the striped bass consumption advisory for San Francisco Bay. It also measured how much the advisory posting on the pier contributed to anglers' awareness of the advisory relative to other information sources. The results show that two thirds of 520 anglers interviewed had an awareness of the advisory. Most learned about the advisory from the sign, although newspaper, friends,

and other media were sources of information about the advisory. Anglers thought that posting was the best way of informing bay anglers about the advisory. Although a majority of anglers (86.4%) who responded believed that following health advisories is important, less than one third of anglers changed their fish consumption habits as a result of the advisory. The low percentage of changed fishing habits was mainly because pier anglers do not catch or eat striped bass. Some information was obtained on how ethnic groups may differ in their responses to some questions, such as preferred information sources and relative importance of following the advisory. These comparisons were difficult to quantify due to not having direct information on ethnicity.

In spite of the study limitations, the survey results do give a good measure of baseline knowledge of anglers' awareness of the advisory for this area. It would be useful, however, to conduct a future survey to find out how awareness of the more recent interim advisory, which does cover most fish species in the bay rather than just stripped bass, has affected angler consumption habits.

From this survey we conclude that posting signs is probably the single most effective way to reach anglers with information about fish consumption advisories. Nevertheless, it is clear from reviewing other angler surveys that efforts need to be made to communicate through multiple means and to provide education that will encourage anglers to follow the advisory recommendations.

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Human Dimensions Research Unit
Department of Natural Resources
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Fernow Hall, Cornell University, Ithica, N.Y. 14853

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APPENDICES

APPENDIX A: TEXT OF STRIPED BASS WARNING SIGN

WARNING

STRIPED BASS IN THE BAY CONTAIN MERCURY, A CHEMICAL THAT CAN CAUSE HEALTH PROBLEMS.

- DO NOT EAT STRIPED BASS OVER 35 INCHES LONG.
- CHILDREN UNDER 6 YEARS, PREGNANT AND NURSING WOMEN SHOULD EAT NONE AT ALL, OR NOT MORE THAN 1/2 LB. PER MONTH. THEY SHOULD NOT EAT ANY STRIPED BASS OVER 27 INCHES.
- ADULTS SHOULD EAT NO MORE THAN 4 LBS. PER MONTH.
- CHILDREN AGES 6-15 SHOULD EAT NO MORE THAN 2 LBS. PER MONTH.

APPENDIX B: SURVEY QUESTIONNAIRE

Surveyor Name:
Location:
Date:
Day of Week:
Time:
Begin End
Weather: • Sunny • Partly cloudy/ Overcast
• Foggy • Rainy

Approach someone who is fishing. Do not ask questions when someone is obviously busy. If someone is cutting bait, ask if they have time to talk.

Observed Sex: • Male • Female

• Did not approach due to drinking or aggressive behavior

1. Hello, how's the fishing today? Is anything biting?
   - Refusal/Would not talk to you.
   - Language Barrier
     Language spoken:_____

2. My name is _____. I'm with the California Office of Environmental Health Hazard Assessment. We're talking to people who fish from San Francisco Bay. We aren't here to enforce any regulations; we just want to learn about people who fish, so that we can serve you better. Could I have five or ten minutes of your time to ask you some questions? All of your answers will be confidential - in other words, I won't ask your name, so no one will know who you are.
   - Yes CO NTINUE
   - No GO TO 3
     3. Language spoken:
     _____
     END SURVEY

There are no right or wrong answers. Please answer questions as best you can. If you don't want to answer a question, we can skip that question.

4. How long have you fished at this pier?
   - Less than 1 month
   - More than 1 month, but less than 1 year
   - 1-2 years
   - 3-4 years
   - 5-9 years
   - 10 years or more

5. Do you fish at other places in the Bay?
   - Yes CONTINUE
   - No GO TO 8

6. Can you tell me at which other places in the Bay you fish?

_____

7. How long have you fished at other places in the Bay?
   - Less than 1 month
   - More than 1 month, but less than 1 year
   - 1-2 years
   - 3-4 years
   - 5-9 years
   - 10 years or more

8. Have you heard or seen any health warnings about eating fish caught in San Francisco Bay? (THIS QUESTION DOES NOT APPLY TO SHELLFISH. CLARIFY IF NECESSARY.)
   - Yes CONTINUE
   - No GO TO 14

9. Where did you hear or see the warning? (Did you hear the warning from other places, too?) CHECK ALL THAT APPLY.

- Family
- Friend
- Fishing Regulations
- Bait Shop
- Newspaper
- Radio
- Sign or Poster
  Where was it located?(Could you be more specific?) _____
  _____
  _____
- Television
- Warden, ranger, or other type of official
- Other _____

- I don't know

10. What did the warning say? CHECK ALL THAT APPLY.

- Don't eat any fish from the Bay
- Don't eat certain kinds of fish from the Bay
- People should eat limited amounts of certain fish from the Bay
- Certain people should eat less fish from the Bay than others
- Pregnant women and/or children should eat less fish from the Bay than others
- Beware of certain toxins in some Bay fish
- Fish from different places in the Bay
- The Bay is polluted

- Striped bass from the Bay contain high mercury levels
- Don't eat striped bass from the Bay
- People should not eat Bay striped bass that are larger than a certain size
- People should eat limited amounts of striped bass from the Bay
- Certain people should eat less striped bass from the Bay than others
- Pregnant women and/or children should eat less striped bass from the Bay than others
- Other _____

- I don't know

11. After you heard the warning, did you change your eating habits?

- Yes GO TO 13
- No CONTINUE

12. Why didn't you change your eating habits?
CHECK ALL THAT APPLY.

- I don't catch any striped bass from the Bay
- I don't eat any striped bass from the Bay
- I don't eat very much striped bass from the Bay
- I don't think the warning is accurate

- I don't think the warning is important
- People have been eating fish from the Bay for years and they're not sick
- I need the fish I catch from the Bay to feed myself
- I need the fish I catch from the Bay to feed my family
- Other _____

_____

- I don't know

GO TO 14.

13. How did you change your eating habits? (Is there anything else that you did?) CHECK ALL THAT APPLY.
    - Stopped eating all fish
    - Stopped eating all fish from the Bay
    - Stopped eating Bay fish that are larger than a certain size
    - Stopped eating certain kinds of Bay fish
    - Eat limited amounts of certain kinds of Bay fish
    - Give away some or all fish caught in the Bay
    - Release some or all fish caught in the Bay
    - Cook and/or clean fish caught in the Bay differently than before
    - Eat more commercial fish

    - Stopped eating striped bass from the Bay
    - Stopped eating Bay striped bass that are larger than a certain size
    - Eat limited amounts of striped bass from the Bay
    - Give away some or all striped bass caught in the Bay
    - Release some or all striped bass caught in the Bay
    - Other _____

    _____

- I don't know

14. IF INTERVIEWEE MENTIONED AND DISCUSSED STRIPED BASS WARNING SIGN AT FRONT OF BERKELEY PIER IN QUESTIONS 8-13, GO TO 23. IF INTERVIEWEE DID NOT MENTION AND DISCUSS STRIPED BASS WARNING SIGN IN QUESTIONS 8-13, CONTINUE.

Have you seen any signs posted on this pier containing health warnings about eating fish caught in San Francisco Bay?
- Yes CONTINUE
- No GO TO 17

15. Where did you see the sign(s)? (Could you be more specific?) CHECK ALL THAT APPLY.
    - At the front of the pier by the restrooms
    - At the Shorebird Nature Center at the Berkeley Marina
    - At the Berkeley Marina Bait Shop
    - Other _____

    _____

- I don't know

16. What did the sign(s) say?
CHECK ALL THAT APPLY.
    - Don't eat any fish from the Bay
    - Don't eat certain kinds of fish from the Bay
    - People should eat limited amounts of certain fish from the Bay

- Certain people should eat less fish from the Bay than others
- Pregnant women and/or children should eat less fish from the Bay than others
- Beware of certain toxins in some Bay fish
- Fish from different places in the Bay
- The Bay is polluted

- Striped bass from the Bay contain high mercury levels
- Don't eat striped bass from the Bay
- People should not eat Bay striped bass that are larger than a certain size
- People should eat limited amounts of striped bass from the Bay
- Certain people should eat less striped bass from the Bay than others
- Pregnant women and/or children should eat less striped bass from the Bay than others
- Other _____

- I don't know

IF INTERVIEWEE MENTIONED AND DISCUSSED STRIPED BASS WARNING SIGN AT FRONT OF BERKELEY PIER IN QUESTIONS 14-16, GO TO 20.
IF INTERVIEWEE DID NOT MENTION AND DISCUSS STRIPED BASS WARNING SIGN IN QUESTIONS 14-16, CONTINUE.

17. Have you seen any signs posted on this pier that warn people who fish about mercury in Striped Bass?
    - Yes CONTINUE
    - No GO TO 24

18. Where did you see the sign(s)? (Could you be more specific?) CHECK ALL THAT APPLY.
    - At the front of the pier by the restrooms
    - At the Shorebird Nature Center at the Berkeley Marina
    - At the Berkeley Marina Bait Shop
    - Other _____

- I don't know

19. What did the sign(s) say about mercury in Striped Bass?
CHECK ALL THAT APPLY.
    - Striped bass from the Bay contain high mercury levels
    - Don't eat striped bass from the Bay
    - People should not eat Bay striped bass that are larger than a certain size
    - People should eat limited amounts of striped bass from the Bay
    - Certain people should eat less striped bass from the Bay than others
    - Pregnant women and/or children should eat less striped bass from the Bay than others
    - Other _____

- I don't know

20. After you saw the mercury in Striped Bass sign(s), did you change your eating habits?
- Yes GO TO 22
- No CONTINUE

21. Why didn't you change your eating habits?
CHECK ALL THAT APPLY.
- I don't catch any striped bass from the Bay
- I don't eat any striped bass from the Bay
- I don't eat very much striped bass from the Bay
- I don't think the warning is accurate
- I don't think the warning is important
- People have been eating fish from the Bay for years and they're not sick
- I need the fish I catch from the Bay to feed myself
- I need the fish I catch from the Bay to feed my family
- Other _____

- I don't know

GO TO 23.

22. How did you change your eating habits? (Is there anything else that you did?) CHECK ALL THAT APPLY.
- Stopped eating all fish
- Stopped eating all fish from the Bay
- Stopped eating striped bass from the Bay
- Stopped eating Bay striped bass that are larger than a certain size
- Eat limited amounts of striped bass from the Bay
- Give away some or all striped bass caught in the Bay
- Release some or all striped bass caught in the Bay
- Eat more commercial fish
- Other _____

- I don't know

23. What were your thoughts when you first saw the mercury in Striped Bass sign(s)? CHECK ALL THAT APPLY.
- I already knew the information on the sign
- I was not surprised/ I knew the Bay was polluted
- I was surprised/ I had no idea
- I was angry
- I didn't care
- I was concerned
- Other _____

- I don't know

24. What are the best ways for us to reach people fishing from the Bay with information about sport fish and health?
CHECK ALL THAT APPLY.
- Posters or leaflets at Bait Shop
- Television
- Newspaper
- Radio
- Signs at fishing locations
- Talking to anglers at fishing locations
- Fishing Regulations
- Other _____

- I don't know

25. How important do you think it is to follow health advisories about what kinds of fish and how much fish is healthy for people to eat?
- Very important
- Important
- Not too important
- Not important at all

26. We also need some background information for our survey. This is so we can understand who we are talking to today. May I ask how old you are? _____

27. Which city do you live in?_____

- Alameda
- Albany
- Berkeley
- Concord
- Daly City
- Danville
- El Cerrito
- Emeryville
- Fremont
- Hayward
- Lafayette
- Livermore
- Martinez
- Other _____
- Moraga
- Oakland
- Piedmont
- Pinole
- Pleasanton
- Richmond
- Rodeo
- San Francisco
- San Leandro
- San Pablo
- Union City
- Vallejo
- Wal nut Creek

28. What language or languages are you comfortable <u>speaking</u>?
- English
- Spanish
- Russian
- Korean
- Filipino
- Chinese
- Other _____
- Japanese
- Vietnamese
- Cambodian

29. What language or languages are you comfortable <u>reading</u>?
- English
- Spanish
- Russian
- Korean
- Filipino
- Chinese
- Other _____
- None
- Japanese
- Vietnamese
- Cambodian

THANK PERSON.
END SURVEY.

APPENDIX C: CITY WHERE RESPONDENTS LIVE

CITY	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Alameda	8	1.5	8	1.5
Albany	7	1.3	15	2.9
Antioch	5	1.0	20	3.8
Bakersfield	1	0.2	21	4.0
Benicia	1	0.2	22	4.2
Berkeley	55	10.6	77	14.8
Burlingame	1	0.2	78	15.0
Castro Valley	6	1.2	84	16.2
China	2	0.4	86	16.5
Citrus Heights	1	0.2	87	16.7
Concord	16	3.1	103	19.8
Daly City	2	0.4	105	20.2
Danville	2	0.4	107	20.6
Davis	2	0.4	109	21.0
El Cerrito	17	3.3	126	24.2
El Sobrante	1	0.2	127	24.4
Emeryville	5	1.0	132	25.4
Fairfield	2	0.4	134	25.8
Fremont	10	1.9	144	27.7
Hayward	16	3.1	160	30.8
Hercules	1	0.2	161	31.0
Italy	1	0.2	162	31.2
Lansing, MI	1	0.2	163	31.3
Live motor home	1	0.2	164	31.5
Livermore	2	0.4	166	31.9
Lodi	4	0.8	170	32.7
Long Beach	1	0.2	171	32.9
Manteca	1	0.2	172	33.1
Martinez	1	0.2	173	33.3
Merced	1	0.2	174	33.5
Missouri	1	0.2	175	33.7
Modesto	2	0.4	177	34.0
Mountain View	1	0.2	178	34.2
Napa	1	0.2	179	34.4
Newark	1	0.2	180	34.6
Oakland	111	21.3	291	56.0
Pacifica	1	0.2	292	56.2
Pinole	8	1.5	300	57.7
Pittsburg	7	1.3	307	59.0
Pleasant Hill	4	0.8	311	59.8
Reno, NV	1	0.2	312	60.0
Richmond	27	5.2	339	65.2
Rodeo	3	0.6	342	65.8

APPENDIX C, contd.

CITY	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Sacramento	9	1.7	351	67.5
San Diego	2	0.4	353	67.9
San Francisco	11	2.1	364	70.0
San Jose	11	2.1	375	72.1
San Leandro	13	2.5	388	74.6
San Pablo	14	2.7	402	77.3
San Rafael	2	0.4	404	77.7
San Ramon	1	0.2	405	77.9
Santa Clara	1	0.2	406	78.1
South San Fran.	1	0.2	407	78.3
Stockton	2	0.4	409	78.7
Suisun	2	0.4	411	79.0
Texas	1	0.2	412	79.2
Union City	8	1.5	420	80.8
Vacaville	5	1.0	425	81.7
Vallejo	17	3.3	442	85.0
Walnut Creek	2	0.4	444	85.4
NA	76	14.6	520	100.0
TOTAL	520			

APPENDIX D: LANGUAGE OF INTERVIEW

LANGUAGE OF INTERVIEW	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Cambodian	1	0.2	1	0.2
Cantonese	1	0.2	2	0.4
Chinese	18	3.5	20	3.8
English	345	66.3	365	70.2
Italian	1	0.2	366	70.4
Korean	13	2.5	379	72.9
Mandarin	4	0.8	383	73.7
Spanish	41	7.9	424	81.5
Vietnamese	20	3.8	444	85.4
NA	76	14.6	520	100.0
TOTAL	520			

By language groupings used in analysis:

Asian languages	57	11
Spanish	41	8
English	345	66
NA	76	15
TOTAL		100

APPENDIX E: LANGUAGES COMFORTABLE SPEAKING

What languages are you comfortable speaking?	Frequency	Percent
English	368	82.8%
Spanish	19	4.3
Japanese	0	0.0
Korean	13	2.9
Chinese-Cantonese	5	1.1
Chinese-Mandarin	10	2.3
Chinese-unknown	2	0.5
Vietnamese	22	4.9
Cambodian	1	0.2
Filipino	2	0.5
Other	2	0.5
Subtotal	444	100.0%
NA	76	...
TOTAL	520	